

Claims.

1. An optical amplifier comprising at least two sections of amplifying optical fibre, pumping means for optically pumping the at least two sections of amplifying optical fibre and an optical fibre support means for holding the at least two sections of amplifying optical fibre substantially straight during use, wherein the optical fibre support means additionally comprises means to couple light between the at least two sections of amplifying optical fibre.
2. An optical amplifier according to claim 1 wherein the optical fibre support means comprises a substrate comprising at least two channels, each of the at least two sections of amplifying optical fibre being located in a channel of the substrate.
3. An optical amplifier according to claim 2 wherein the at least two channels are formed adjacent and substantially parallel to one another thereby forming a folded arrangement.
4. An optical amplifier according to any one of claims 2 to 3 wherein the channels formed in the substrate have a substantially rectangular cross section.
5. An optical amplifier according to any one of claims 2 to 4 wherein the means to couple light between the at least two sections of amplifying optical fibre comprises one or more hollow core optical waveguides formed in said substrate.
6. An optical amplifier according to claim 5 wherein a reflective coating is provided on the internal surface of the one or more hollow core optical waveguides.
7. An optical amplifier according to any one of claims 2 to 6 wherein the substrate further comprises at least one alignment slot, the at least one alignment slot being arranged to receive an optical component.

8. A optical amplifier according to claim 7 wherein a lens is retained in the at least one alignment slot.
9. An optical amplifier according to any one of claims 2 to 8 wherein the substrate further comprises at least one optical fibre end attachment means.
10. An optical amplifier according to any one of claims 2 to 9 wherein the substrate comprises semiconductor material.
11. An optical amplifier according to any one of claims 2 to 10 wherein the channels are formed in the substrate using a deep reactive ion etching (DRIE).
12. An optical amplifier according to any preceding claim wherein the pumping means provides a pump beam that is routed through each section of amplifying optical fibre in series.
13. An optical amplifier according to any one of claims 1 to 11 wherein the pumping means provides a plurality of pump beams that are separately routed to each section of amplifying optical fibre.
14. An optical amplifier according to any preceding claim wherein the core diameter of at least one section of amplifying optical fibre is greater than 50 $\mu$ m.
15. An optical amplifier according to any preceding claim wherein at least one section of amplifying optical fibre is a multi-mode optical fibre.
16. An optical amplifier according to any preceding claim wherein at least one section of amplifying optical fibre is a single mode optical fibre.
17. An optical amplifier according to any preceding claim wherein the core of at least one section of the amplifying optical fibre comprises a rare earth metal dopant.

18. An optical amplifier according to any preceding claim wherein beam input means are provided for coupling an input beam into a section of amplifying optical fibre.
19. An optical amplifier according to claim 18 wherein the beam input means comprises at least one lens.
20. An optical amplifier according to any one of claims 18 to 19 wherein the beam input means is arranged such that the input beam predominantly excites the fundamental mode of propagation in said section of amplifying optical fibre.
21. An optical amplifier according to any one of claims 18 to 20 wherein the beam input means is arranged to receive the input beam from a single mode optical fibre.
22. An optical amplifier according to any preceding claim wherein beam output means are provided to couple an amplified beam from a section of amplifying optical fibre into an output single mode optical fibre.
23. An optical amplifier according to any preceding claim wherein the pumping means comprises at least one laser.
24. An optical amplifier according to claim 23 wherein the pumping means comprise at least one multimode optical fibre optically coupled to the output of the at least one laser, said multimode optical fibre also being optical coupled to a section of amplifying optical fibre.
25. An optical amplifier according to claim 24 wherein the numerical aperture of the amplifying optical fibre is greater than the numerical aperture of the multimode optical fibre.
26. An optical amplifier according to claim 24 wherein the multimode optical fibre is coupled to a section of amplifying optical fibre via a lens system having a magnification (m), wherein the numerical aperture of the amplifying optical fibre is greater than the

product of the numerical aperture of the multimode optical fibre and the magnification (m).

27. An optical amplifier according any one of claims 1 to 22 wherein the pumping means comprises an array of laser diodes, said array of laser diodes being arranged to apply a pump beam to the side of each section of amplifying optical fibre.

28. A laser device comprising an optical amplifier according to any preceding claim and two selectively reflective elements, wherein the optical amplifier is arranged with respect to the selectively reflective elements to form a resonant laser cavity.